

ject, prepared by Elster and Geitel, will be found in Part II of the Report of the International Meteorological Congress at Chicago, 1893.

#### HURRICANES IN THE WEST INDIES.

From Jos. Ridgway, Jr., St. Thomas, W. I., the Weather Bureau has received the following note, dated October 29:

Thirty years ago we experienced here, on this date, the most severe hurricane ever known in these latitudes. Apparently there is now no further fear of hurricanes for the season 1897, but I may mention as a peculiar feature that on different occasions since the 15th instant the barometer has been lower than at any time during the period 15th July to 15th October.

#### ALTITUDES OF CLOUDS.

The well-known voluntary observer, Mr. Barry C. Hawkins, of Horse Cove station, near Highlands, Macon Co., N. C., requests information with regard to the best methods of determining the altitudes of clouds, applicable to the case where the observer is on a mountain or plateau so high that he is sometimes within the cloud. Under date of November 7 he writes:

In mountain regions the altitudes of clouds are not nearly as great as near the sea level, the relation of the observer to the clouds being entirely changed. For instance, the altitude of a cloud near sea level might be 3,000 feet, the same kind of cloud when passing over a mountain range or plateau 3,000 feet high would touch the earth. Such is the actual case in the Blue Ridge Mountains. In storms the clouds frequently sweep the ground, and at other times the height varies from 0 to 500, 800, or 1,000 feet. When touching the earth the cloud appears like fog and might be called fog, but really the case is entirely different, for the origin is like that of all clouds, and the velocity is often great, being equal to that of the surface winds. When the cloud is dense one can only see a few rods. How can we draw a sharp distinction between such clouds and fogs? It is to be noted that cirrus, cirrostratus, and rarely cumulus are so low in altitude. The clouds of thunderstorms, which are well developed and not connected with any general storm, rarely touch the mountain, peaks of 4,500 feet or more being free from them. But after thunderstorms small clouds, sometimes not more than 10 feet in diameter, will form perhaps only a few feet above the surface and float in various directions with various velocities, but as the atmosphere clears they disappear. I have sometimes used the following method for obtaining the height of general cloud sheets. Suppose an observer is at an altitude of 2,000 feet and sees a cloud sheet touch the summit of a mountain known to be 3,000 feet high. The altitude of the cloud above will equal  $3,000 - 2,000 = 1,000$  feet. Ought such altitudes to be counted as above the observer or as above the sea level?

The altitudes of clouds, as published in connection with the international charts of cloud types are given as above sea level, and this is always to be understood when speaking of clouds unless specifically stated to the contrary. Measurements of clouds are made from elevated points, and in publishing such results, both the measured and the sea level altitudes should be given.

The methods of observation and measurement are so varied that students of the subject should refer to the chapters on this subject in the Editor's Meteorological Apparatus and Methods, Washington, 1887, as also to the articles in the MONTHLY WEATHER REVIEW for April, 1897. The method described by Mr. Hawkins is perfectly proper, and in fact is the one first used by meteorologists in the beginning of the study of this subject; it is quite accurate when there are many clouds whose lower sides are all on the same level, so that an observer by ascending or descending a mountain slope may determine to within a very few yards whether he is on the right level or not. Of course, the actual result depends equally upon the accuracy with which one knows the elevations of his position on the mountain side. This latter consideration is perhaps the most important one when an observer looks upward from below and tries to ascertain at what level the base of the cloud intersects the mountain side. The low clouds that sometimes hang over the city of Wash-

ington often hide the summit of the Washington Monument, 550 feet above the ground or 600 feet above sea level, but owing to the absence of a sufficient number of well-defined marks on the side of the Monument, as well as to the haziness of the cloud, it is rarely possible to determine the altitude of the base of the cloud to within 50 feet. In the case of observers on the broad plains of the Mississippi watershed it is important that they give the heights of clouds above sea level as well as above ground, since, in general, the types and motions of the clouds depend equally upon the pressure, the temperature, and the moisture of the atmosphere.

#### ORIGIN OF THE DESCENDING GUSTS OF WIND.

In the MONTHLY WEATHER REVIEW for August, page 351, the Editor has ventured a few words in connection with an extract from a letter of Mr. Charles A. Love, of Aurora, Ill., who now writes that perhaps the wording of his letter has been misunderstood by the Editor, and that he himself had no idea of suggesting that hail causes the wind, but, on the contrary, that cold, dry wind causes the hail. He intended mainly to raise the question as to—

Whether it is possible for a stratum of cold, dry air to get between an upper and lower rain cloud and freeze the rain which is falling from the upper cloud. Is it possible for a stratum of cold air, of relatively greater density, to overlap the warmer air at the surface and cause a downrush and at the same time freeze rain into hail, if there should be any rain in the path of the descending cold air? It is often said that a hailstorm in a certain locality is the cause of the cold, although the hailstorm is of limited area and the change to cold weather covers a wide area. The cold air causes the hail and not the hail the cold air.

The Editor owes Mr. Love an apology for reading too much meteorology into his former letter. The fact is, as we understand it, that when a great mass of cool, dry, and, therefore, denser air rolls southeastward over the continent, displacing warmer, moister air, the process does produce thundershowers and hailstorms, and still oftener raw, cold gusts without much rain or hail. It is, therefore, not proper to say that hailstorms or thunderstorms produced this spell of cool weather, since it was the cold air that caused them, and to this extent our correspondent is quite correct.

Denser air can not lie quietly above lighter air near the earth's surface for any length of time, but if the former is in rapid motion, as is oftentimes the case, bounding along over the earth's surface like the ricochet of a cannon ball, it must necessarily descend in gusts here and there precisely as observed by Mr. Love. At other times the word *ricochet* does not correctly express the movement, since sometimes the cold wind blows against an obstacle or blows from hilltop to hilltop over a valley before it has time to descend. The descent is usually slow as compared with the horizontal movement.

But there is another equally frequent case in which it is not the cold air that forms the hail, but the hail and rain that forms the cold gust. This latter case is due to two very different modes of action. The first, or simplest of comprehension, is a simple mechanical process; the descending raindrops or hailstones, by the momentum of their fall and the viscosity or internal friction of the air, drive some air before them, so that beneath the column of falling rain the air is pushed outward in all directions, especially southeastward, in the line of least resistance. The second is a thermodynamic action; the falling rain or hail, no matter whether it is entering warmer air or whether it is driving in front of it air that becomes warm by compression, is in either case being evaporated, and as this evaporation consumes heat (i. e., renders it latent), therefore, the rain, the hail, and the air are each cooled in proportion to the quantity of heat that they give up to the process of evaporation; of course the air in the region at a distance from the falling hail is not cooled. The heavy, cold air thus formed descends with the rain and,

striking the earth, is pushed outward in all directions as a cold gust. Not only rain and hail, but every collection of small particles of water constituting a fog or cloud cools the air into which it is allowed to evaporate. If, therefore, a layer of dry air is flowing over a layer of cloudy air, the mixture of the dry air with the cloud and the consequent evaporation of the cloud into it will always produce a mixture, or a resulting moister air, that is sufficiently cold to fall rapidly downward. These mixtures of masses of air having different temperatures and moistures are those treated of by Brillouin in a memoir which is published on an earlier page of this REVIEW; they constitute the ordinary phenomena of cloudy weather. Knowing the pressure, temperature, moisture, and movement of the two masses of air, we should be able to predict the cloud phenomena, and *vice versa*; knowing the clouds, we must learn to infer something as to the temperature and other conditions of the air.

#### RECENT EARTHQUAKES.

With regard to the seismograph kept in operation at Adelbert College, Cleveland, Ohio, by Prof. E. W. Morley, he reports that no disturbances were recorded during the month of October. With regard to its sensibility he notes that—

The instrument is one that records on smoked glass the horizontal components of any earth tremor and it would not be easy to alter the construction of the lever which determines the ratio of the trace to the original motion.

October 2, 8:42 a. m., shocks were felt at San Francisco; 8:45, Alma and Santa Cruz, Cal.

On October 21 an earthquake shock was felt at 10:20 p. m., at Salem, Va.; 10:30 p. m., Wytheville, Va., preceded by a

rumble; 10:30 p. m., Winston, N. C., two waves in close succession. At Washington, D. C., the Marvin seismograph recorded earthquake shocks at 10:25 p. m., and frequently between 10:25:40 and 10:26:40.

#### DISTANT CLOUD BANKS.

For many years the Editor has been accustomed to keep notes and diagrams of the banks of clouds that are often seen low down in the distant horizon. The easiest way of making the record is pictorial, using a small circle with north, south, east, west lines intersecting at the center. On this circle the symbols and arrows showing the movements of clouds can easily be located, a full line to indicate the lowest wind; a dashed line, the lower clouds; a dotted line, the upper clouds. Whenever a cloudy area approaches from the west, the bank of clouds appears from one to twelve hours earlier in the distant horizon. Whenever a hurricane passes up the coast, perhaps even entirely at sea, the observer at Washington notices first a cloud bank having its maximum altitude in the south-southeast, subsequently in the southeast, and finally disappearing in the northeast. Such observations and records go a long way to eke out the information given by the morning weather map. For instance, on Monday, October 4, 8 a. m., Hatteras reported a northeast wind of 32 miles, threatening weather, and falling barometer. Over the rest of the Middle Atlantic States northerly winds and clear weather prevailed. At Washington the cloud bank was observed to have its maximum altitude of about 10° in the southeast; the upper edge of the bank cut the horizon at the points south-southeast and east-northeast, and seemed to indicate the presence of a storm area fully 500 miles away.

#### METEOROLOGICAL TABLES.

By A. J. HENRY, Chief of Division of Records and Meteorological Data.

Table I gives, for about 130 Weather Bureau stations making two observations daily and for about 20 others making only the 8 p. m. observation, the data ordinarily needed for climatological studies, viz, the monthly mean pressure, the monthly means and extremes of temperature, the average conditions as to moisture, cloudiness, movement of the wind, and the departures from normals in the case of pressure, temperature, and precipitation; the altitudes of the instruments, the total depth of snowfall, and the mean wet-bulb temperatures are now given.

Table II gives, for about 2,400 stations occupied by voluntary observers, the extreme maximum and minimum temperatures, the mean temperature deduced from the average of all the daily maxima and minima, or other readings, as indicated by the numeral following the name of the station; the total monthly precipitation, and the total depth in inches of any snow that may have fallen. When the spaces in the snow column are left blank it indicates that no snow has fallen, but when it is possible that there may have been snow of which no record has been made, that fact is indicated by leaders, thus (. . .).

Table III gives, for about 30 Canadian stations, the mean pressure, mean temperature, total precipitation, prevailing wind, total depth of snowfall, and the respective departures from normal values. Reports from Newfoundland and Bermuda are included in this table for convenience of tabulation.

Table IV gives detailed observations at Honolulu, Republic of Hawaii, by Curtis J. Lyons, meteorologist to the Government Survey.

Table V gives, for 26 stations, the mean hourly temperatures deduced from thermographs of the pattern described

and figured in the Report of the Chief of the Weather Bureau, 1891-92, p. 29.

Table VI gives, for 26 stations, the mean hourly pressures as automatically registered by Richard barographs, except for Washington, D. C., where Foreman's barograph is in use. Both instruments are described in the Report of the Chief of the Weather Bureau, 1891-92, pp. 26 and 30.

Table VII gives, for about 130 stations, the arithmetical means of the hourly movements of the wind ending with the respective hours, as registered automatically by the Robinson anemometer, in conjunction with an electrical recording mechanism, described and illustrated in the Report of the Chief of the Weather Bureau, 1891-92, p. 19.

Table VIII gives, for all stations that make observations at 8 a. m. and 8 p. m., the four component directions and the resultant directions based on these two observations only and without considering the velocity of the wind. The total movement for the whole month, as read from the dial of the Robinson anemometer, is given for each station in Table I. By adding the four components for the stations comprised in any geographical division one may obtain the average resultant direction for that division.

Table IX gives the total number of stations in each State from which meteorological reports of any kind have been received, and the number of such stations reporting thunderstorms (T) and auroras (A) on each day of the current month.

Table X gives, for 56 stations, the percentages of hourly sunshine as derived from the automatic records made by two essentially different types of instruments, designated, respectively, the thermometric recorder and the photographic